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International application number: PCT/US05/014514

International filing date: 27 April 2005 (27.04.2005)

Document type: Certified copy of priority document

Document details: Country/Office: US  
Number: 60/566,147  
Filing date: 27 April 2004 (27.04.2004)

Date of receipt at the International Bureau: 06 June 2005 (06.06.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)



World Intellectual Property Organization (WIPO) - Geneva, Switzerland  
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1325747

UNITED STATES OF AMERICA

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United States Patent and Trademark Office

*May 24, 2005*

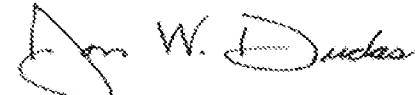
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FILING DATE.

APPLICATION NUMBER: 60/566,147

FILING DATE: April 27, 2004

RELATED PCT APPLICATION NUMBER: PCT/US05/14514

Certified by



Under Secretary of Commerce  
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PTO/SB/16 (01-04)  
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### PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. EL919129030US

2251 U.S.PTO  
60/566147



#### INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Rafael	Garcia	Tempe, Arizona

*Additional inventors are being named on the* 1 *separately numbered sheets attached hereto*

#### TITLE OF THE INVENTION (500 characters max)

METHOD TO SYNTHESIZE HIGHLY LUMINESCENT MAGNESIUM DOPED GALLIUM NITRIDE POWDERS

Direct all correspondence to: CORRESPONDENCE ADDRESS

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Address				
Address				
City	State		Zip	
Country	Telephone		Fax	

#### ENCLOSED APPLICATION PARTS (check all that apply)

<input checked="" type="checkbox"/> Specification Number of Pages <u>1</u>	<input type="checkbox"/> CD(s), Number _____
<input type="checkbox"/> Drawing(s) Number of Sheets _____	<input checked="" type="checkbox"/> Other (specify) <u>postcard</u>
<input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76	

#### METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT

<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27.	FILING FEE Amount (\$)
<input checked="" type="checkbox"/> A check or money order is enclosed to cover the filing fees.	
<input checked="" type="checkbox"/> The Director is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: <u>070135</u>	<u>\$80.00</u>
<input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.	

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

<input checked="" type="checkbox"/> No.	
<input type="checkbox"/> Yes, the name of the U.S. Government agency and the Government contract number are: _____	

Respectfully submitted,

[Page 1 of 2]

Date 4/27/2004

SIGNATURE

REGISTRATION NO. 24,583

(if appropriate)

Docket Number: 9138-0155

TYPED or PRINTED NAME Thomas D. MacBlain

TELEPHONE 602-530-8088

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This collection of information is required by 37 CFR 1.51. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop Provisional Application, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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**PROVISIONAL APPLICATION COVER SHEET**  
**Additional Page**

PTO/SB/16 (08-03)

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Docket Number 9138-0155

<b>INVENTOR(S)/APPLICANT(S)</b>		
Given Name (first and middle [if any] )	Family or Surname	Residence (City and either State or Foreign Country)
Fernando A.	Ponce	Tempe, Arizona
Abigail	Bell	Tempe, Arizona

[Page 2 of 2]

Number 1 of 1

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# FEE TRANSMITTAL

## for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

 Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT (\$ 80)

## Complete if Known

Application Number	
Filing Date	herewith
First Named Inventor	Garcia
Examiner Name	
Art Unit	
Attorney Docket No.	9138-0155

## METHOD OF PAYMENT (check all that apply)

 Check  Credit card  Money Order  Other  None
 Deposit Account:

Deposit Account Number	070135
Deposit Account Name	Gallagher & Kennedy, P.A.

The Director is authorized to: (check all that apply)

- Charge fee(s) indicated below  Credit any overpayments  
 Charge any additional fee(s) or any underpayment of fee(s)  
 Charge fee(s) indicated below, except for the filing fee to the above-identified deposit account.

## FEE CALCULATION

## 1. BASIC FILING FEE

Large Entity	Small Entity	Fee Description	Fee Paid
Fee Code (\$)	Fee Code (\$)		
1001 770	2001 385	Utility filing fee	
1002 340	2002 170	Design filing fee	
1003 530	2003 265	Plant filing fee	
1004 770	2004 385	Reissue filing fee	
1005 160	2005 80	Provisional filing fee	80
SUBTOTAL (1) (\$)			80

## 2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

Total Claims	-20** =	X	=	Fee from below	Fee Paid
Independent Claims	- 3** =	X	=		
Multiple Dependent					

Large Entity	Small Entity	Fee Description
Fee Code (\$)	Fee Code (\$)	
1202 18	2202 9	Claims in excess of 20
1201 86	2201 43	Independent claims in excess of 3
1203 290	2203 145	Multiple dependent claim, if not paid
1204 86	2204 43	** Reissue independent claims over original patent
1205 18	2205 9	** Reissue claims in excess of 20 and over original patent
SUBTOTAL (2) (\$)		

\*or number previously paid, if greater; For Reissues, see above

## 3. ADDITIONAL FEES

Large Entity Small Entity

Fee Code (\$)	Fee Code (\$)	Fee Description	Fee Paid
1051 130	2051 65	Surcharge - late filing fee or oath	
1052 50	2052 25	Surcharge - late provisional filing fee or cover sheet	
1053 130	1053 130	Non-English specification	
1812 2,520	1812 2,520	For filing a request for ex parte reexamination	
1804 920*	1804 920*	Requesting publication of SIR prior to Examiner action	
1805 1,840*	1805 1,840*	Requesting publication of SIR after Examiner action	
1251 110	2251 55	Extension for reply within first month	
1252 420	2252 210	Extension for reply within second month	
1253 950	2253 475	Extension for reply within third month	
1254 1,480	2254 740	Extension for reply within fourth month	
1255 2,010	2255 1,005	Extension for reply within fifth month	
1401 330	2401 165	Notice of Appeal	
1402 330	2402 165	Filing a brief in support of an appeal	
1403 290	2403 145	Request for oral hearing	
1451 1,510	1451 1,510	Petition to institute a public use proceeding	
1452 110	2452 55	Petition to revive - unavoidable	
1453 1,330	2453 665	Petition to revive - unintentional	
1501 1,330	2501 665	Utility issue fee (or reissue)	
1502 480	2502 240	Design issue fee	
1503 640	2503 320	Plant issue fee	
1460 130	1460 130	Petitions to the Commissioner	
1807 50	1807 50	Processing fee under 37 CFR 1.17(q)	
1806 180	1806 180	Submission of Information Disclosure Stmt	
8021 40	8021 40	Recording each patent assignment per property (times number of properties)	
1809 770	2809 385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810 770	2810 385	For each additional invention to be examined (37 CFR 1.129(b))	
1801 770	2801 385	Request for Continued Examination (RCE)	
1802 900	1802 900	Request for expedited examination of a design application	

Other fee (specify) \_\_\_\_\_

\*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$)

(Complete if applicable)

Name (Print/Type)	Thomas D. MacBlain	Registration No. (Attorney/Agent)	24,583	Telephone	602-530-8088
Signature	4/27/2004				

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant: Garcia et al.

Filed: Herewith

Title: **METHOD TO SYNTHESIZE HIGHLY LUMINESCENT MAGNESIUM  
DOPED GALLIUM NITRIDE POWDERS**

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**CERTIFICATE OF MAILING BY EXPRESS MAIL**  
**"Express Mail" mailing label number EL919129030US**

Mail Stop Provisional Patent Application  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Commissioner:

I hereby certify that the following correspondence is being deposited in the United States Postal Service as Express Mail on the date shown below in an envelope addressed as shown above.

1. Provisional Application for Patent Cover Sheet (2 pages);
2. Fee Transmittal for FY 2004 (1 page in duplicate);
3. Specification (1 page plus cover sheet);
4. Check for \$80.00; and
5. A return receipt postcard.

4/27/04  
Date

Suzanne Shields  
Suzanne Shields

GALLAGHER & KENNEDY, P.A.  
2575 East Camelback Road  
Phoenix, Arizona 85016-9255  
Tel. No. (602) 530-8000  
Fax. No. (602) 530-8500

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**Provisional Patent Application**

**Title:** **METHOD TO SYNTHESIZE HIGHLY LUMINESCENT  
MAGNESIUM DOPED GALLIUM NITRIDE POWDERS**

**Inventor(s):** Rafael Garcia, Tempe, Arizona  
Fernando A. Ponce, Tempe, Arizona  
Abigail Bell, Tempe, Arizona

**Attorneys for Applicant:** Thomas D. MacBlain  
Donna H. Catalfio  
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2575 East Camelback Road  
Phoenix, AZ 85016-9225

## METHOD TO SYNTHESIZE HIGHLY LUMINESCENT MAGNESIUM DOPED GALLIUM NITRIDE POWDERS

This invention solves the problem of:

1. Low luminescence efficiency in p-type gallium nitride powders; and
2. Doping and co-doping GaN-powders for electroluminescent devices.

We have developed a new method to produce magnesium-doped gallium nitride powders.

This method has a high control over the concentration of magnesium in the final product. The method consists in reacting a gallium-magnesium alloy with ultra-high purity ammonia in a horizontal quartz tube reactor at 1100°C during three hours.

The gallium magnesium alloy is prepared using a mechanical mixer. Ultra-high purity gallium melt and magnesium powder are placed in a stainless steel sealed vessel under vacuum at 300°C and the vessel is mechanically mixed for several hours in order to produce a highly homogeneous alloy.

We have been working on the synthesis of gallium nitride and related compounds as part of a GaN microcrystalline powder project supported by a gift from Durel Corporation (now a division of Rogers Corporation). Professor Fernando A. Ponce and I (Rafael Garcia) planned my second year of postdoctoral stay at Arizona State University (ASU), this second year with the emphasis on learning how to dope such GaN powders. This work is of high scientific as well as technological importance. Durel's gift allowed us to explore directions which were not main stream to current technology. The importance of these powders is in their potential as electroluminescent phosphors. The first stage involved production of GaN powders with high crystalline quality and high light emission efficiency. The second stage involved learning to dope such powders. We started with a new series of experiments using magnesium as an acceptor agent and we found that it is possible to produce magnesium doped gallium nitride powder using a gallium-magnesium alloy as a precursor. Also we found that through this method it is possible to control the concentration of magnesium in the gallium nitride powders. The material produced resulted in surprisingly high Mg-related luminescence.

This invention can be used as a method to produce p-type GaN phosphors that can be used as active material in electroluminescent devices.